OPTIMIZING ACTIVITY BASED COSTING (ABC)

Captain Anthony J. Gutterman
Los Angeles AFB
and
James R. Aldrich, Ph.D.
Rust Environment and Infrastructure
1452 Corporate Point
Warner Robins, GA 31088
james_aldrich@ccmail.rustei.com

INTRODUCTION

Activity Based Costing is a method to identify the specific costs of providing products and services and assign them to the activities that cause those costs. For example, if a process generates 4 barrels of hazardous waste per week, the disposal costs for the waste would be charged to the generating process. However, the current practice in most cases is to simply lump all environmental compliance costs in an overhead account that is then applied equally to all cost centers within a company making it difficult to determine the actual cost of providing any given service. The reason a company would adopt an ABC system is to ensure that the cost burden of providing each product or service in a company is identified and charged specifically to the responsible cost center. This, in essence, forces each product or service to generate sufficient revenues to cover the costs they generate.

There is little question that industry has embraced the concept of Activity Based Costing (ABC) and literature shows benefit cost ratios of up to 100 times the initial start-up investment. However, these measurements are generally made after ABC is implemented. As a result, the analysis is based on total pre-ABC cost vs. total post-ABC cost. This implies that the only conclusion that can be drawn is whether or not ABC was economically beneficial when the real question should be whether or not the ABC application was optimized.

ABC Benefit/Cost Model

Optimizing ABC, as well as any other investment endeavor, means that the marginal benefit of using ABC is equal to the marginal cost. Hence, these two factors must be measured. On the benefit side, the advantage of implementing ABC is easy to define, the system provides accurate cost information, but difficult to measure – what is the dollar value of this information. Conversely, the three cost elements of implementing ABC, computer hardware/software, personnel training, and data entry/analysis, are relatively easy to estimate.

The benefit is available under the concept that if people are forced to pay for costs, they will do everything in their power to reduce those costs. The result is that it must be presumed that the personnel will be empowered with the authority to make changes to reduce costs. If this can be assumed, estimating the benefit can be relatively straightforward. If a company is a candidate for ABC, it follows that they are currently rolling environmental costs into overhead (i.e., the waste generators do not pay for the environmental services they require). In a similar context Goddard (1995)[1] found that the elasticity of demand for waste management services was 0.20 (measured as a reduction in waste generated). This implies that each unit increase in price for the waste generator will result in a 20% reduction in waste generation. If it can be assumed that a waste generator who goes from paying none of the cost to paying all of the cost for environmental services will fall into the same category as a generator who saw a cost increase, the 20% savings predicted by Goddard should be applicable. This implies that every dollar charged back to the waste generator will create $.20 in benefits. These percentage savings were also supported by other data collected by Goddard[2]

This 20% savings establishes a minimum level to the benefit of ABC. However, to complete the picture, one must consider the effects of investing the savings. If the waste generator is given the capability of investing the savings realized from his or her efforts into pollution prevention projects, the net benefit can be increased. Ogden (1996)[3], Friend (1994)[4] and the U.S. Department of Energy (1995) [5] have documented an approximate payoff for pollution prevention investments of 3:1. Factoring this into the ABC benefit means that every $1.00 charged back to a cost center gives the generator $.20 to invest in pollution prevention. This equates to a pollution prevention savings of $.60 or a net savings for ABC of $.60 - $.20 invested = $.40; a 40% return on or every dollar charged back to a waste generator.

On the cost side, the three cost elements, computer hardware/software, personnel training, and data entry/analysis are more easily defined. Because most companies have an established computer system, the first element is generally limited to a software purchase. ABC software costs run from $7,000 to $11,000 depending upon whether it is for a single organization or if a network license is required and costs for training the ABC champion are included in this total. This study assumed that no additional hardware was needed and there would be an $11,000 total investment for software and training. To simplify the analysis, the life of the software was taken to be 1 year with the entire cost depreciated within that time. If the software were used longer than this, the cost per year would be less making the analysis conservative in that the costs would be lower. This one-year life was continued throughout the analysis

The final cost element, data entry/analysis, is a combination of two factors. First, the ABC champion who was trained by the software provider must set up the system.

---

[1] Goddard, Haynes C., "The Benefits and Costs of Alternative Solid Waste Management Policies," Resource, Conservation, Recycling Journal: 183 (June 1995)
[2] ibid
[3] Ogden, Douglas H., "Booosting Prosperity: Reducing the Threat of Global Climate Changes Through Sustainable Energy Investments," 1996, WWW address: http://www.crest.org/efficiency/aceee/pubs/e963.html.
[4] Friend, Gill, "Light Bulbs, Trade Wars and Shareholder Suits," *The New Bottom Line*, 22 Feb 94, WWW Address: http://www.eco-ops.com/eco-ops/nbl/nb..3.3.html.
[5] U.S. Department of Energy, Office of Federal Energy Management Program, *Federal Energy Management: Billions Saved, Billions More to Come*, 1995, The Federal Energy Management Program, WWW Address: http://www.eren.doe.gov/femp/bsbmtc.html.

Depending upon the complexity of the system, this task has been estimated to take from 50 to 200 hours.[6] For this study, it was assumed that establishing the database would require 150 hours. Second, an allowance must be made for both the analysis and data entry; it takes time for the employee providing environmental services to enter the time and equipment charges into the ABC software database. It was assumed that this task would require no more than 10% of the total time spent on a given environmental service. Hence, if an employee spent an average of 10 hours/month manifesting hazardous waste, 1 hour would be allotted to entering the data and performing the ABC analysis.

To transform hours in to dollars, hourly costs had to be assigned to each environmental employee. The following enlisted, officer and general schedule employee pay groupings were developed:

Group	Pay Categories	Hourly Rate ($/hr)
A	E3 and E4	11.00
B	E5-E8, O1, O2, GS7-GS11	17.00
C	E9, O3, O4, GS12, GS13	24.00
D	O5, GS14, GS15	34.00

A survey of 3 Air Force bases showed most installation-level environmental employees to be in cost categories B or C. To predict the costs for this study, it was assumed that the ABC champion would be a category B employee and other employee's pay categories were computed according to the actual staffing for a given organization. Hence, the benefit can be estimated ($.40 for every dollar charged back), the software costs are known ($11,000), and the data entry/analysis/training costs can be estimated/computed from actual workers salaries.

Field Testing:

The two environmental management personnel, both category B, at Cheyenne Mountain AFB were asked to detail the time they spent on a variety of environmental tasks[7] for each customer on their installation. The ABC costs, as outlined above, were computed and compared to the potential benefits for all of the customers receiving their environmental services on a net present value basis. It was discovered that at Cheyenne Mountain, the benefits outweighed the potential ABC costs for all customers.

To investigate the sensitivity of the analysis, the expected benefit was lowered and the calculations repeated iteratively until the cost of the ABC system was greater than the expected benefit; this occurred at a benefit level of 26%. Similarly, the benefit was held constant at 40% and the estimated time required for data entry/analysis was

[6] Spinner, Paula C., Senior Analyst, Secretary of the Air Force, WWW Address: http://www.saffm.hq.af.mil/SAFFM/FMC/abc8.html

[7] Environmental task areas taken from Sullivan, F.P. Thomas, *Environmental Law Handbook, Thirteenth Edition*, Maryland: Government Institutes, Inc., 1995, p. 333.

varied until the expense of providing ABC analysis for one of the customers became greater than the benefit. This provided a percent return required (i.e., minimum benefit) vs. percent of labor required for data analysis relationship as shown in Figure 1.

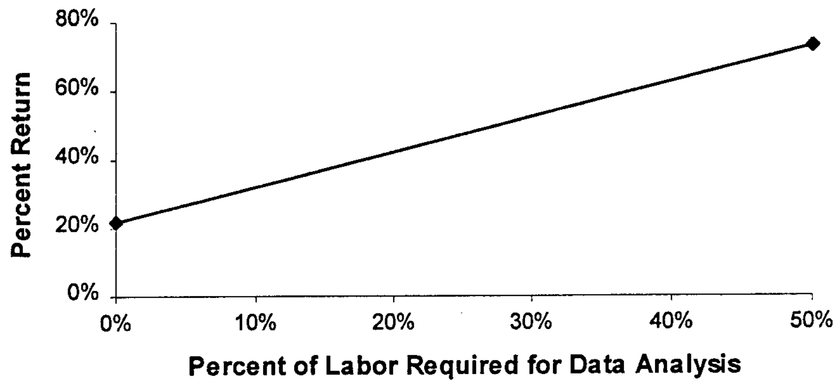

Figure 1. Sensitivity Analysis for ABC Optimization Techniques: Minimal Return vs. Percent Labor Needed to Charge Environmental Costs to All Customers.

This graph enables the analyst to investigate whether or not ABC would be financially beneficial under a variety of different circumstances. For example, if an analyst thought the benefit expected was in line at 40%, but that the percentage of time allotted for data entry and analysis was too low. The graph shows that for a 40% return the time spent on data analysis can be as high as 19% and ABC would still provide a positive net present value. Similarly, if the 10% of labor spent on data analysis was considered correct, the graph shows that the percent return could be as low as 31% and still provide a positive net present value.

A similar analysis was performed to determine the combinations of return and percent time for data analysis at which it became financially unattractive to track any of the activities at Cheyenne Mountain AFB. Figure 2 shows the results of this second analysis superimposed over the Figure 1 graph shown previously.

Again, interpreting this graph is relatively easy. The analyst considering implementing ABC first determines whether the 40% benefit and 10% costs appears high or low. Then the chart is used with the selected combination of expected percent return and percent labor. If the selected data pair is above the top line of the chart, charging all activities for environmental services will result in a positive net present value. Conversely, if the percent return/percent data pair is below the bottom line of the chart, ABC cannot return a positive net present value.

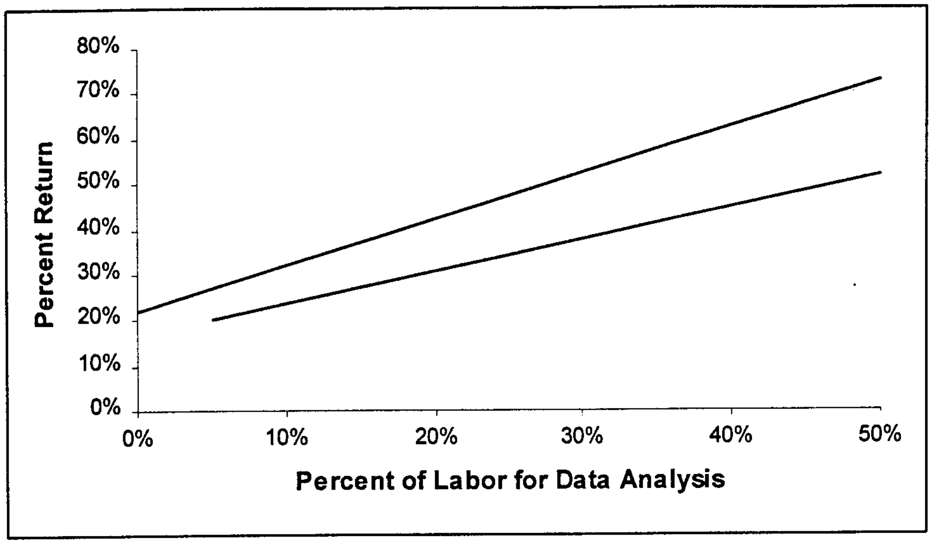

Figure 2. Sensitivity Analysis for ABC Optimization Techniques: Minimal Return/ Percent Labor Needed to Charge Environmental Costs to Any and All Customers.

The final possibility for Figure 2 is the data pair falling between the two lines. This indicates that only some of the activities should be charged for environmental services to ensure a positive net present value for each. To determine which activities to charge and which to exclude from ABC requires the net present value of ABC to be computed for each activity using the selected values for percent return and percent of labor. Any activity with a negative present value is then dropped and the analysis is repeated. The reason the analysis must be continued is because by dropping the activities with a negative present value, the costs for the software, hardware, and training must now be spread over fewer customers increasing their share of this expense. These calculations are continued until all of the activities show a positive net present value.

This analysis was completed for two other air force bases with environmental budgets nearly ten times larger than Cheyenne Mountain ($1,600,000 vs. $196,000). In addition, the software/training costs were spread over 1, 2 and 3 years.[8] In each case the analysis showed that all customers could be charged for environmental services.

On the surface, it would seem that the optimization model is of little use if in fact all organizations examined should charge all environmental costs to all customers. However, this is a function of how two of the variables were defined when the model was established; the environmental activities to track and what constituted a customer. First, the definition of an environmental activity had to be defined in that these functions performed by the environmental staff form the basis of how the environmental personnel

[8] Gutterman, Anthony J., "Development of Activity Based Costing (ABC) Optimization Tool for an Environmental Organization, Master's Thesis, Air Force Institute of Technology, AFIT/GEE/ENV/97D-08.

track their time. If the activities were too general or defined too broadly, it would have been difficult to establish a cost center. Conversely, if they had been defined too specifically, there would have been too many customers. This would have increased the cost of maintaining the database.

The second variable, the definition of a customer for the environmental organization, would determine the costs of administering the ABC system. More customers would mean more recordkeeping for the environmental personnel, more analysis time for the ABC champion, etc. For example, if the mission of the Air Force is to fly and fight, at one extreme all costs could be charged to the flying squadron as a single cost center. Unfortunately, this is very similar to lumping all costs into a single overhead account. As is the case with overhead, it makes little sense to charge the flying squadron because they are neither responsible for providing the services nor do they have they any control over the processes that generate the requirements for environmental services; they would have responsibility but no control. At the other extreme, customer selection can become too specific by taking it from a group to a flight to a section to a shop, etc. In this latter case, narrowing the definition would create a great deal of specificity for customers and costs, but the data would soon become too cumbersome to analyze or collect.

The value of the optimization model is apparent. If the analysis shows that few if any customers can be charged for environmental services, the definitions of customer as well as activity could be altered and the model run again. If the variables are selected correctly, using the optimization model can do many things for a company. First, it will ensure that only the customers who stand to gain more than they lose (e.g., the marginal benefits are equal to or outweigh the marginal costs) will be selected for ABC implementation. Second, it can be used to determine the overall benefit of using ABC if the net present values for each customer are simply added. Finally, it allows for post implementation investigation to see if the expected savings have been realized. If they have not, then the assumed values for return and data input/analysis can be revisited. If the expected savings have been exceeded, the new data can be input to the model. This could have the effect of expanding ABC to include the customers who had been excluded due to a negative net present value. This would have the net effect of further increasing benefits. The model can serve as a quick check as well as a basis for detailed analysis to ensure that only those specific activities that would benefit will be included in the ABC system.